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HOLT
INSTRUMENT
LABORATORIES
OCONTO WISCONSIN

MEASUREMENT



OPERATING AND SERVICE MANUAL
FOR
AUDIO FREQUENCY OSCILLATOR
MODEL AO-400 A

Serial No. 2004 - 400 cps
1000 cps

HOLT INSTRUMENT LABORATORIES
OCONTO, WISCONSIN



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CLAIM FOR DAMAGE IN SHIPMENT:

The Instrument should be tested as soon as it is received. If it fails to operate properly, or it is damaged in any way, a claim should be filed with the carrier. Also, notify Holt Instrument Laboratories or the local Representative immediately. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. We will advise you of the disposition to be made of the equipment and arrange for repair or replacement. Include model number and serial number when referring to this instrument for any reason.

WARRANTY:

Holt Instrument Laboratories warrants each instrument manufactured by them to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose and to replace any defective parts thereof. Electron tubes, fuses and batteries are specifically excluded from any liability. This warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid, and when upon our examination it is to our satisfaction defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. In this case an estimate will be submitted before the work is started.

If any fault develops, the following steps should be taken:

1. Notify either the factory or the area Holt representative, giving full details of the difficulty, and include the model and serial numbers. Upon receipt of this information we will give you service data or shipping instructions.
2. On the receipt of shipping instructions, forward the instrument prepaid to the factory or the authorized repair station indicated in the instructions. If requested, an estimate of the charges will be made before the work begins if such work is not covered by warranty. All shipments of Holt Instrument Laboratories equipment should be packed in a strong exterior container surrounded by two or three inches of shock absorbing material.

TECHNICAL SPECIFICATIONS

OUTPUT VOLTAGE:	0 to 2 Volts RMS into a 600 ohm load
OUTPUT FREQUENCIES:	Switch selected up to 10 KC
OUTPUT WAVEFORM:	Sinusoidal
DISTORTION:	0.1% Max.
NOISE AND HUM:	66 db below 1 Volt
SHORT-TERM VOLTAGE STABILITY:	+ .05% as measured with test circuit described in this manual
POWER REQUIRED:	105 to 125 Volts RMS 60 cycles 150 watts
MECHANICAL:	19" Rack & Panel Mounting 7" high 13" deep Weight: Approx. 20 lb.

SECTION I GENERAL DESCRIPTION

1-1 GENERAL:

The Holt Model AO-400 Audio Oscillator is a low distortion instrument covering up to 10 fixed frequencies. The oscillator is specifically designed for use with the Holt Instrument Model AVS-321 Audio Voltage Standard. The oscillator has a short-term amplitude stability of 0.05%. This highly stable amplitude prevents variations on the output of the AVS-321 which would occur at rates too fast for the AVS-321 Servo Regulator to follow. To accomplish this the AO-400 is designed to eliminate all amplitude variations which would occur at rates faster than 0.1%/second. Amplitude variations slower than this are eliminated by the AVS-321 Servo Regulator.

The AO-400 also provides an extremely low distortion level. It is therefore an ideal instrument for use in the calibration of rectifier type voltmeters the accuracy of which is a function of waveform factor.

The AO-400 consists of a beat frequency oscillator, followed by a tuned audio frequency amplifier. The RF frequency of the beat frequency oscillator is determined by high stability temperature controlled crystals. The master oscillator operates at a frequency of 100 KC and the beat oscillator is switched to 100.4 KC, or 101.0 KC depending on the desired output frequency. The tuned Wien bridge amplifier is ganged to the frequency selection switch and is used to reduce the distortion in the mixer output. The output of the tuned amplifier is connected through a 600 ohm T pad to the output terminals.

1-2 POWER CABLE:

The three conductor power cable is terminated in a polarized three-prong male connector recommended by the National Electrical Manufacturer's Association. The third contact is an offset ground pin, added to a standard two-prong a-c plug, which grounds the instrument chassis when used with the appropriate receptacle. To use this NEMA plug in a standard two-prong outlet, a three-prong to two-prong adapter should be used. The ground connection emerges from the adapter as a short lead which should be connected to ground for the protection of the operating personnel. Also, large amounts of noise or 60 cycle voltage on the instrument chassis will affect the hum level and amplitude stability.

1-3 OPERATING TEMPERATURE:

The AO-400 crystal oscillators use an oven temperature of 55°C. The units should be provided with adequate ventilation to keep the temperature below 45°C. or frequency drift may be increased due to poor oven temperature regulation.

SECTION II OPERATING INSTRUCTIONS

2-1 CONTROLS AND TERMINALS:

ON-OFF POWER SWITCH: This toggle switch located on the lower left-hand side of the front panel connects power to the filament transformers and crystal ovens and starts the thermal time delay. After about 30 seconds the thermal time delay connects power to the plate transformer.

FUSES: The fuse holder on the left side of the front panel supplies power to the filament transformer, oven heaters and the heater of the thermal time delay. It is an 0.75 amp cartridge fuse and a spare fuse is mounted in the holder below.

The fuse at the lower right of the panel is a 0.75 amp fuse supplying power to the primary of the plate transformer through the contacts of the thermal time delay relay. A spare fuse is mounted below it.

2-2 FREQUENCY SELECTOR:

The rotary switch at the upper left of the panel selects the two output frequencies of 400 cycles or 1 KC. It selects the proper crystal in the beat oscillator and the tuned circuit in the Wien bridge amplifier.

2-3 OUTPUT LEVEL:

The output level control located on the upper right of the panel is a 600 ohm T pad connected between the output of the selective amplifier and the output terminals.

2-4 OPERATING PROCEDURE:

When the instrument is turned on the time delay relay will allow an initial 30 second warm-up before turning on the plate power. When this delay is completed the ready light on the panel will come on. At this point, the instrument is ready for use. However, the crystal ovens do require about 10 minutes to reach final temperature and some frequency drift will occur during this period. A warm-up of 20 minutes or more is recommended for maximum frequency and amplitude stability.

After warm-up the operator selects the desired frequency and adjusts the output level to the desired setting.

SECTION III AMPLITUDE STABILITY

3-1 SHORT-TERM AMPLITUDE STABILITY:

The AO-400 is designed as a companion to the Holt AVS-321 Audio Voltage Standard. The AVS-321 utilizes a servo mechanical voltage regulator to control the long-term absolute calibration of its output voltage. This servo regulator has a time constant of approximately 200 milliseconds. If the input to the AVS-321 has small amount of amplitude modulation at rates too fast for the servo to track this, amplitude modulation will appear in the output of the AVS-321. If the AVS-321 is used to calibrate voltmeters which have high resolution and a speed of response faster or comparable to that of the servo regulator, these modulation or jitter components will be visible as fluctuations in the meter reading or, in the case of digital voltmeters, as instability in the least significant digit.

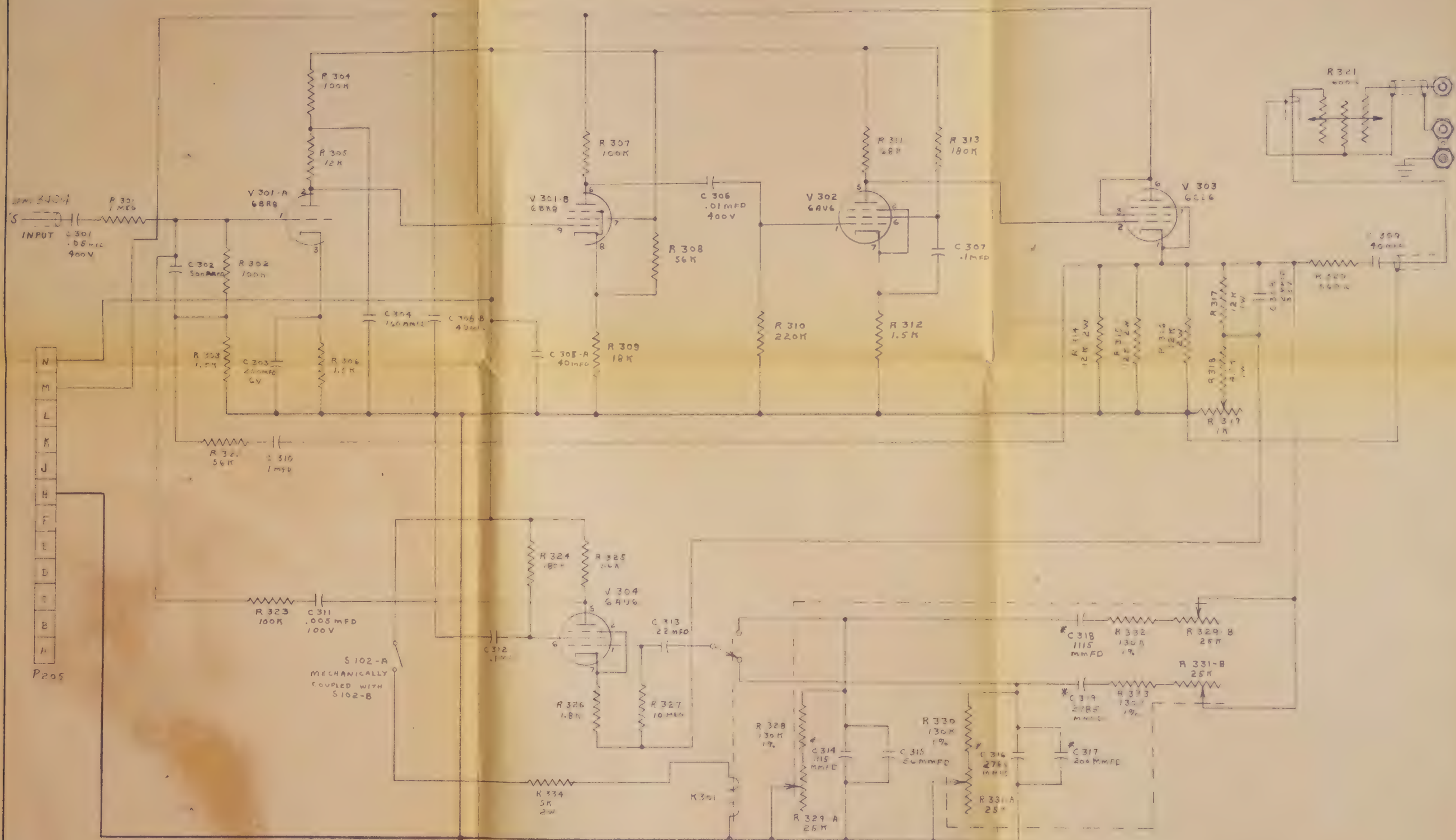
To define short-term amplitude stability we must define the regulating characteristics of the AVS-321 and the sensitivity characteristic of the voltmeters being calibrated. Most of the high resolution high speed voltmeters are of the rectifier type. The Fourier analysis of a full wave rectified waveform indicates the presence of at least 120% peak to peak second harmonic ripple. To reduce this ripple to 0.012% so that it will have negligible effect on the high resolution voltmeter reading an attenuation of at least 80 db is required. If a maximum filter slope of 40 db/decade is used the smoothing filter must have a cut-off frequency no higher than 1/20th of the lowest frequency to be measured. For example, a meter designed to measure frequencies down to 30 cycles would have a cut-off of 1.5 cycles and a time constant of no less than 110 milliseconds. Therefore, if the output of the oscillator is stable enough that its output averaged over 110 milliseconds is varying at a rate of less than .1%/second the voltmeter will filter out all variations faster than this and the AVS-321 servo will regulate out the slower variations. If we use this as a criterion for the short-term amplitude stability of the oscillator used to drive the AVS-321 output will have an amplitude stability of $\pm .05\%$ or better when averaged over any period longer than 110 milliseconds.

Holt Instrument Laboratories has designed a test circuit which is used to check an oscillator for this type of performance. This circuit is shown on Dwg. 1392 in the rear of this manual. It contains a full wave rectifier and two filters, one having a time constant of 110 milliseconds the other 1500 to 2000 milliseconds. The output of the faster is viewed on an oscilloscope having a sensitivity of at least 1 millivolt/cm. Since fast variations are passed by the faster filter while the slow filter reacts even slower than an AVS-321 regulator the difference between the two filter outputs as viewed on the scope

will contain the short-term transients that we wish to measure. A calibration switch is provided with which the input amplitude may be changed by a step percentage allowing the operator to calibrate his oscilloscope. Typical scope deflection is 70 millivolts/1% with a 2 volt input to the test circuit. Therefore, on a scope with a DC coupled amplifier and a sensitivity of 1 mv/cm* a peak to peak deflection of 7 cm will equal $\pm .05\%$. The AO-400 output should hold within this limit.

*Tektronix 535 with D plug in.

Analog Model 1100 with 700 plug in.

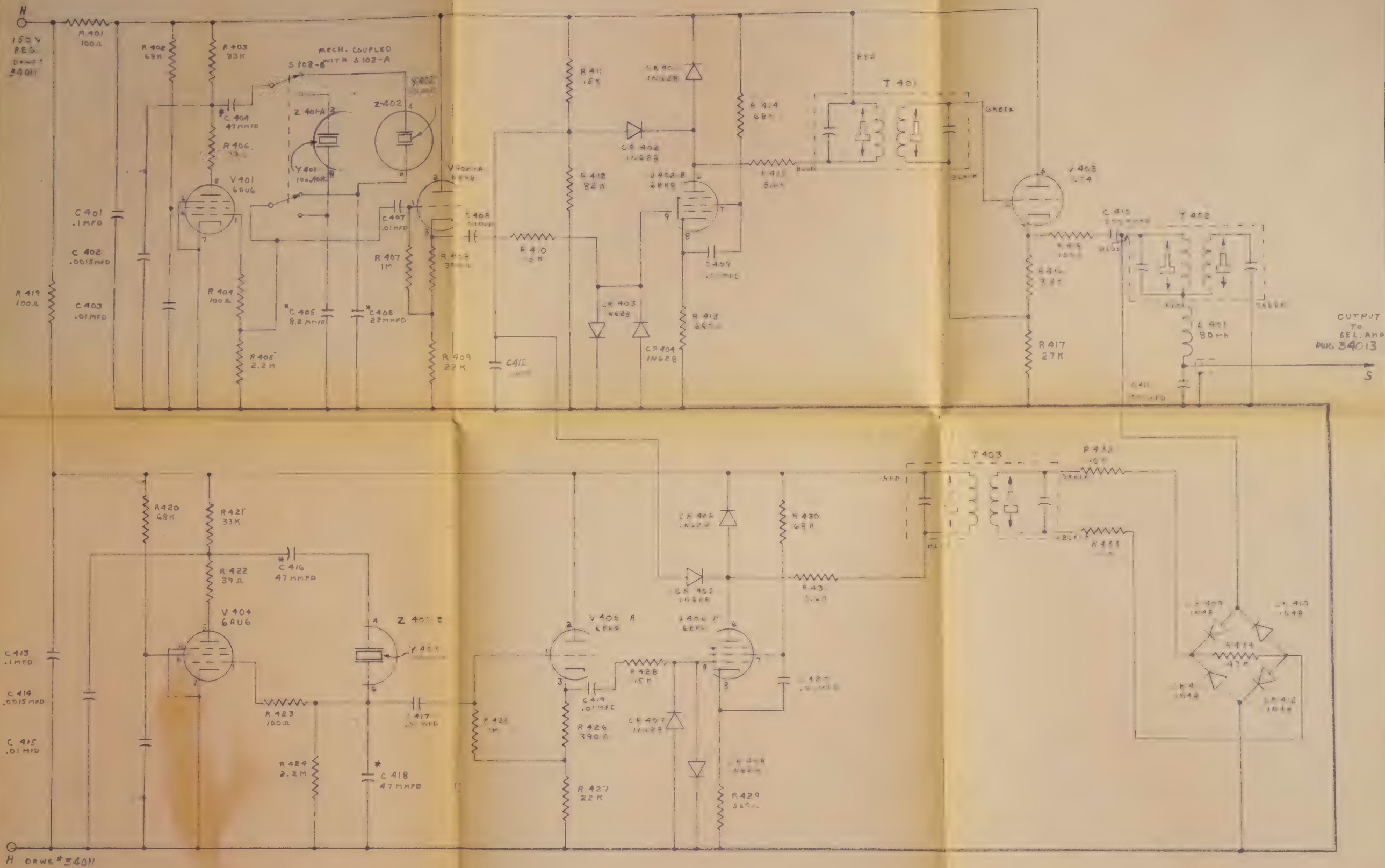


* ADJUSTED FOR OPTIMUM
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TITLE SELECTIVE AMPLIFIER		MODEL A-400A	
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NOTE: * ADJUSTED FOR OPTIMUM
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TITLE OSCILLATOR CIRCUIT

DATE 4-11-61

MODEL AO-400A

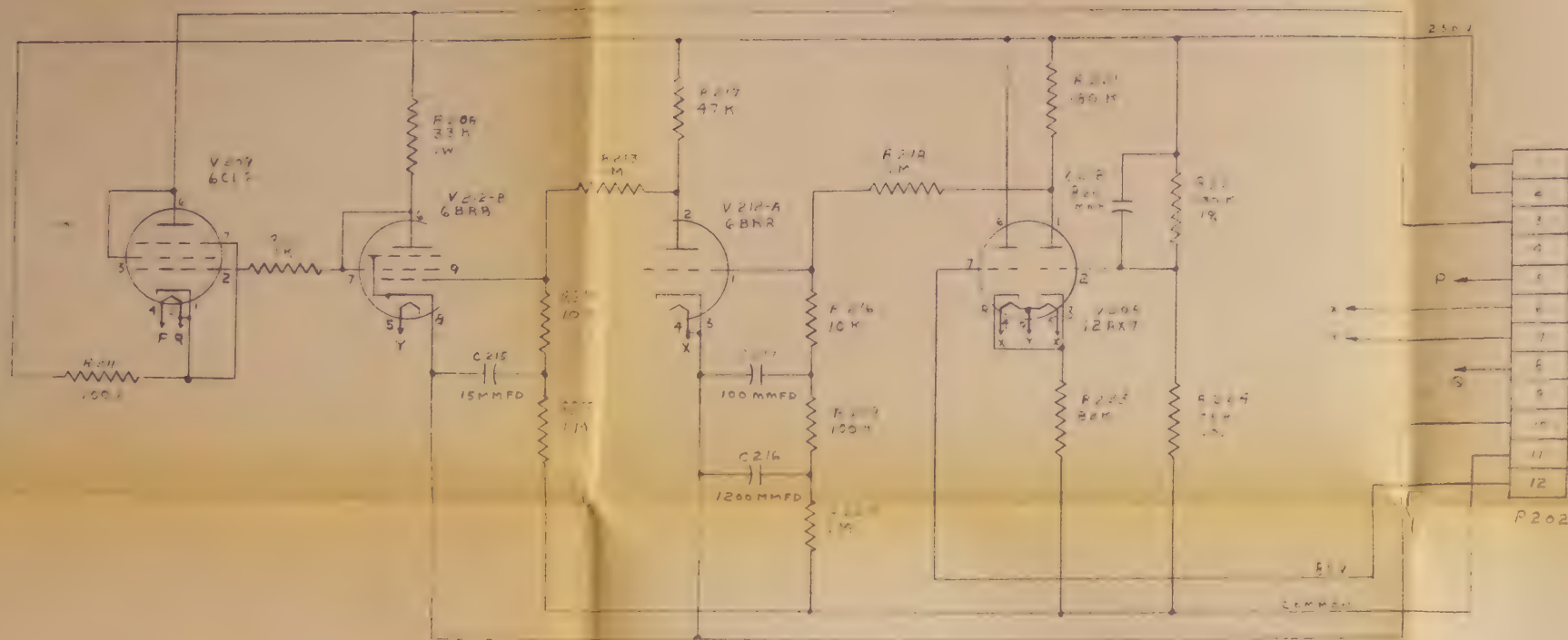
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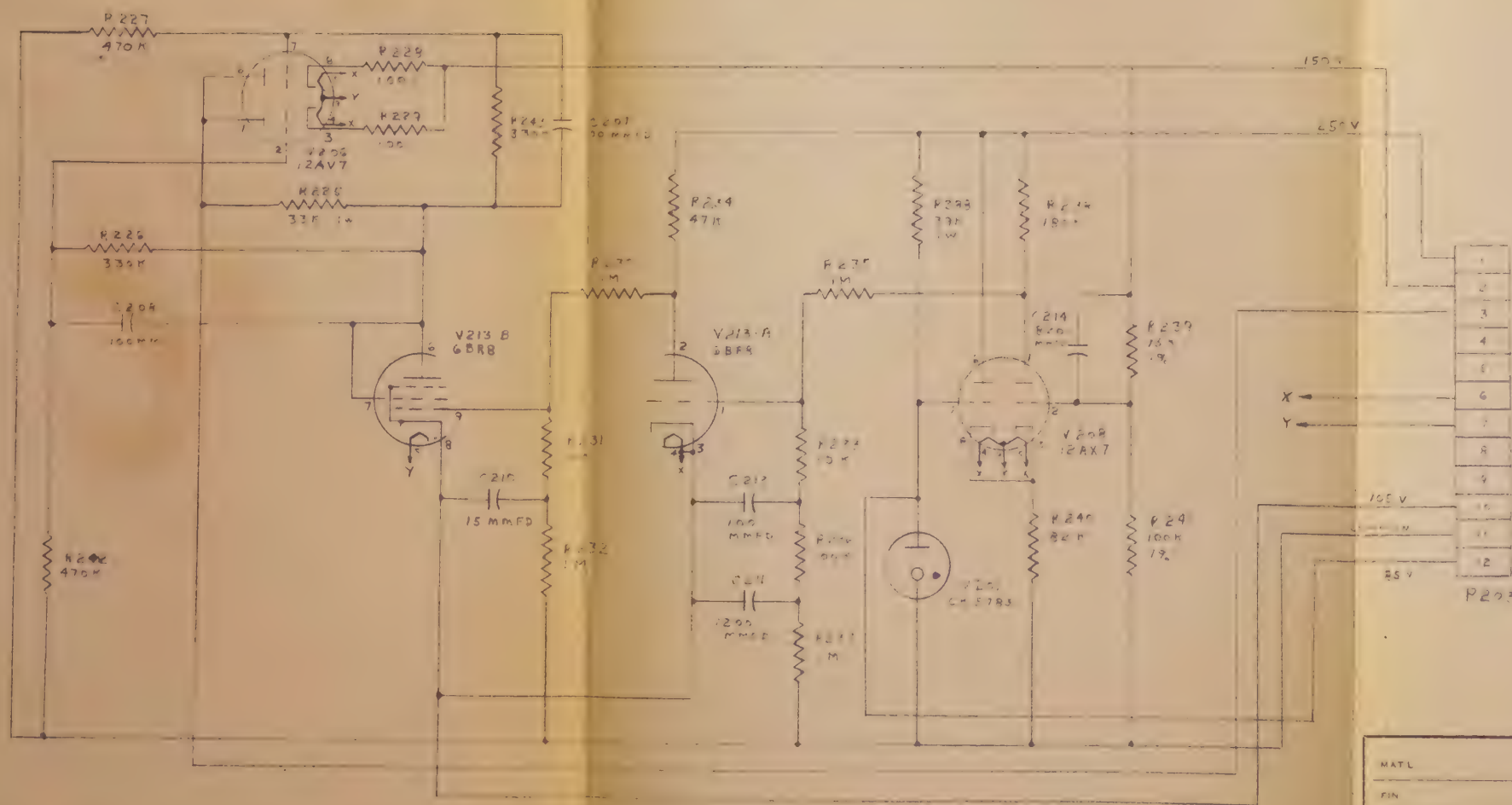
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TOLERANCE PRCT DEC SCALE



250 VOLT REGULATOR



150 VOLT REGULATOR

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OSCONTO WISCONSIN

TITLE 150 VOLT REGULATOR

DATE 4-15-61 MODEL 1009004

APPROVED DRAWING NO.

DRFT 1009004

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OCUNTO WISCONSIN

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DATE 9-13-61

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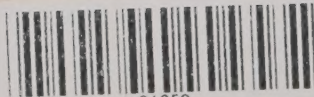
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